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To:

Commissioner  
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 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

Date of mailing (day/month/year) 12 February 2001 (12.02.01)	
International application No. PCT/US00/12547	Applicant's or agent's file reference GIC-575 PCT
International filing date (day/month/year) 08 May 2000 (08.05.00)	Priority date (day/month/year) 21 May 1999 (21.05.99)
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1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 12 December 2000 (12.12.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Zakaria EL KHODARY Telephone No.: (41-22) 338.83.38
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(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
30 November 2000 (30.11.2000)

PCT

(10) International Publication Number  
**WO 00/72586 A2**

(51) International Patent Classification<sup>7</sup>: **H04N 5/44**

(21) International Application Number: **PCT/US00/12547**

(22) International Filing Date: **8 May 2000 (08.05.2000)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
**60/135,268** **21 May 1999 (21.05.1999)** **US**

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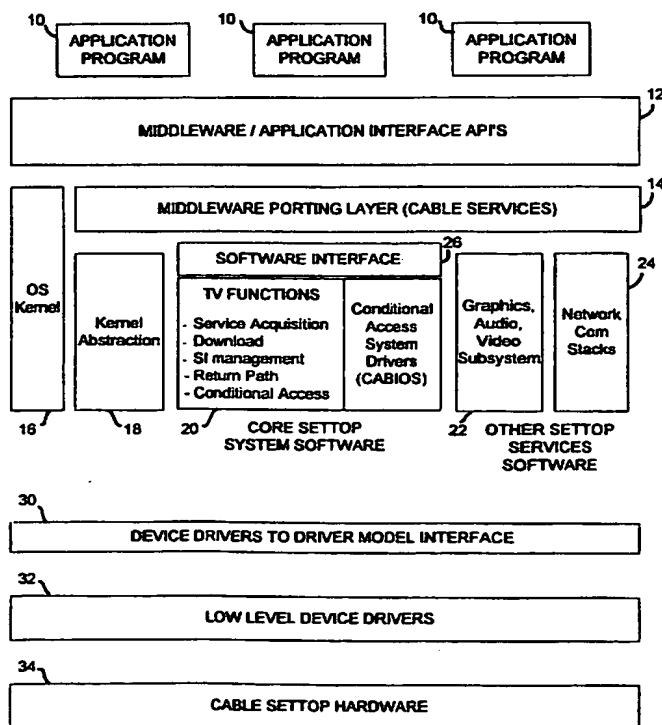
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(81) Designated States (national): **AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.**

(84) Designated States (regional): **ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU,**

[Continued on next page]

(54) Title: **PROGRAMMING INTERFACE FOR TELEVISION SETTOP CORE SYSTEM SOFTWARE**



(57) Abstract: A software interface (26) is provided to enable television settop middleware (14) and operating system (OS) software (16) to control and interact with core settop system software (20) in a subscriber television terminal to facilitate the provision of desirable digital television services, including service acquisition (e.g., acquisition of a pay-per-view movie), system information management, settop configuration and control, return path for polling, download capability including authentication and authorization, and non-volatile memory management.

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MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

- *Without international search report and to be republished upon receipt of that report.*

## PROGRAMMING INTERFACE FOR TELEVISION SETTOP CORE SYSTEM SOFTWARE

### BACKGROUND OF THE INVENTION

This application claims the benefit of U.S.  
5 Provisional Application No. 60/135,268, filed May 21,  
1999.

The present invention provides a software  
architecture that enables core software of a television  
settop terminal to be compatible with different settop  
10 middleware and operating system software. In  
particular, a software interface defines the functions  
and parameters passed between (i) middleware and  
operating system provider software, and (ii) core settop  
software provided in a television settop box or the  
15 like.

The recent advent of digital settop terminals has  
spurred the growth of subscriber television networks,  
such as cable/satellite television networks. Such  
terminals can support increased levels of programming  
20 services and a variety of software-based applications  
and functions, such as an electronic program guide,  
stock or weather banners, shop and bank at home  
services, games, and the like. Moreover, this trend is  
expected to continue with the convergence of telephone,  
25 television and computer networks, and the rise of in-  
home computer networks.

A "user terminal" (e.g., digital settop box) for  
cable or satellite television, or the like, requires OS  
software, middleware and device drivers to function.

OS software provides the multithreading, real-time OS support needed to operate the settop.

Middleware is software that connects two otherwise separate applications. For example, such middleware can  
5 be provided to mediate between an application program and a network, thereby managing the interaction between disparate applications across heterogeneous computing platforms. More generally, middleware serves as the glue between separate applications, and is sometimes  
10 referred to as "plumbing" because it connects two sides of an application and passes data between them.

Moreover, drivers are used to control different hardware devices in a terminal, such as tuners, demodulators, MPEG-2 decoders (e.g., audio, video, and  
15 data), video encoders, audio mixers, and so forth.

In a settop box, "core software" is provided that allows the settop to provide such necessary television functions as service acquisition, system information (SI) management, download capability (e.g., for new  
20 application and OS software), return path communication (e.g., for polling the settop for billing purposes), settop configuration, and conditional access control (i.e., security).

In the past, each settop has only been designed to  
25 use one particular operating environment. The problem of handling multiple operating environments has not previously been addressed in the settop environment. Generally, applications have been ported to various operating environments either through rewrite of the  
30 settop system software to that environment or through an abstraction layer.

Accordingly, it would be advantageous to enable a choice of different operating environments on a settop

without the need to change the core settop system software. This would enable the reuse of a single settop design for multiple operating environments. It would also enable faster implementation of alternate  
5 operating software environments, permitting a faster time to market new settop devices.

In particular, the software architecture should that allow a customer, such as a cable television system operator, to choose the operating environment, including  
10 the OS kernel, middleware and application software, and device drivers, that will be used in the settop. The core settop system software should allow the device to operate within a common system environment. The architecture should allow for the development of the  
15 core software, and then implementation of the architecture in any of a plurality of different operating environments, such as VRTX, Windows CE, AperiOS, PowerTV and other settop operating environments.

20 The architecture should enable middleware and OS software to control and interact with the core settop system software to facilitate the provision of desirable digital television services, such as service acquisition, determining the status of a service,  
25 configuring the settop, indicating an unsolicited event, and managing user privacy.

The architecture should be suitable for terminals that receive programming services via any type of network, including broadband communications networks,  
30 Digital Subscriber Loop (DSL) networks, and others. The present invention provides an interface to core settop system software that enjoys the aforementioned and other advantages.

It would further be desirable to have an interface to core settop software that operates in such an architecture.

5 In particular, the interface of the invention defines each interface point between the "Application OS/Middleware" layer of the settop software and the core settop system software. This provides a mechanism by which the Application OS/Middleware software can control and interact with the core settop system software.

### SUMMARY OF THE INVENTION

A software interface is provided to enable settop middleware and OS software to control and interact with core settop system software. The interface enables the  
5 middleware and OS software to interact with the core system software to facilitate the provision of desirable digital television services.

An apparatus in accordance with the invention provides an interface to core system software in a  
10 television subscriber terminal, and includes a computer readable medium having computer program code means, and means for executing the computer program code means to provide at least one application program interface (API) to enable middleware that mediates between an  
15 application program and said core system software to access a function of the terminal.

A corresponding method is also presented.



**BRIEF DESCRIPTION OF THE DRAWING**

The Figure is a high level overview of a television  
settop box architecture incorporating a software  
interface between the middleware/OS layer and the core  
5 settop system software in accordance with the invention.

## DETAILED DESCRIPTION OF THE INVENTION

The Figure illustrates a software platform, or architecture, for implementing a settop box in accordance with the present invention. The platform can be  
5 implemented using any suitable operating system, such as the VRTX (virtual real-time executive) operating system available from Mentor Graphics Corporation of Wilsonville, Oregon, Windows CE available from Microsoft Corporation of Redmond, Washington, AperiOS available  
10 from Sony Corporation of New York, N.Y., PowerTV available from PowerTV, Inc. of Cupertino, CA, etc. Other operating systems can be used.

The architecture can be considered to include three main levels, including a lower level (functions  
15 30, 32 and 34) related to hardware and device driver functions, a middle level (functions 14, 16, 18, 20, 22, 24 and 26) related to the core settop software, and a high level (functions 10, 12) related to middleware and applications.

Specifically, the top level of the software  
20 structure comprises one or more application programs 10 which can comprise, for example, the Digital Television (DTV) navigator application (available from Network Controls International, Inc. of Charlotte, North  
25 Carolina), interactive games, enhanced television features, Internet web browsers, etc. These applications need to communicate with the core settop system software 20. This communication is accomplished with the middleware/application interface 12, the  
30 middleware porting layer 14, and the software interface 26 of the present invention.

The next layer in the software structure comprises

middleware/application interface APIs (application  
program interfaces) 12. This layer 12 is part of the  
operating environment (i.e., it is OS-specific), and  
provides the interface to the application program(s) 10  
5 which execute in the settop (e.g., cable settop hardware  
34). The layer 12 provides facilities for applications  
to use and control the settop box resources, and to  
coexist with other applications. The layer 12 also  
provides the environment in which the applications  
10 execute. Layer 12 also provides the API to which  
applications are written, providing an authoring  
environment. Moreover, this layer 12 handles the issues  
of shared resources, multiple applications, application  
selection, application launch and application  
15 termination. Preferably, it provides a consistent  
interface to the end user.

A middleware porting layer 14, e.g., for cable, DSL  
or other television services, is provided to translate  
the television, graphics and communication interfaces  
20 20, 22 and 24, respectively, to the particular  
functional interface required by a middleware software  
component and specified by the middleware  
provider/vendor. Middleware providers often specify an  
interface on which their software has been tested and  
25 proven. This layer 14, which is also part of the  
operating environment, allows portability of the  
middleware solution to the settop in an expedient  
manner. More specifically, the layer 14 allows the core  
settop system software 20 to remain the same while  
30 allowing different middleware layers to execute.

An operating system (OS) kernel 16 is provided at  
the levels of the middleware porting layer 14 and the  
core settop system software 20, the graphics, audio,

video subsystem 22 and the network communication stacks 24. This kernel 16 can comprise, for example, a MIPS (million instructions per second) port of the VRTX kernel version 4.0, available from the Microtec division of Mentor Graphics Corporation for the Motorola 68000 family of microprocessors. This kernel 16 provides the multithreading, real time OS support needed to operate the settop. The OS kernel 16, together with the middleware porting layer 14 and middleware/application interface APIs 12, and the device drivers are components of the operating environment. More particularly, the OS kernel 16 provides OS facilities such as multitasking, inter-task communication, synchronization, and memory management. These facilities are used to create tasks, set task priorities, communicate between tasks, and synchronize operation of the system tasks and application tasks.

A kernel abstraction component 18 provides generic kernel functions needed by the other components. In particular, component 18 abstracts these functions from the specifics of the OS kernel 16. The kernel abstraction component 18 includes two sections, namely, (i) the kernel calls used by the components, and (ii) the kernel-specific translations. Some of the supported kernel features are implemented in a fashion that is independent of the underlying kernel.

The kernel abstraction component 18 may separate the details of the OS kernel from the core settop system software 20, and be used to isolate the core system software from the specifics of an OS kernel implementation. In this manner, portability of the core software 20 between operating environments is provided. The OS kernel abstraction 18 provides standard types of

OS services in a generic way to the core system software 20. These services include, e.g., messaging, thread operations, memory management, synchronization, and event management.

5       The core settop system software 20 contains support for the television system features. For example, this software can be written to support the DigiCipher® II digital television system features. DigiCipher® II is a proprietary system developed by General Instrument  
10 Corporation of Horsham, Pennsylvania, U.S.A., the assignee hereof. This system includes features that are specific to the cable television environment for downstream and upstream communications. The features supported by the core settop system software 20 include,  
15 without limitation, service acquisition (e.g., acquisition of a pay-per-view movie), system information management, settop configuration and control, return path for polling, download capability including authentication and authorization, and non-volatile  
20 memory management.

      The core settop system software 20 also includes conditional access system drivers (CABIOS), which are used to provide security and access control. This component supports the features of object  
25 authentication, object authorization, resource authorization, cryptographic tool kit, and baseline privacy key exchange. The interface layer for the cryptographic tool kit (Crypto Toolkit) is the Public Key Cryptography Standards (PKCS) 11 standard.

30       More specifically, the core settop system software 20 provides the services that allow the settop to exist in a communication (e.g., cable television) network. As noted above, the functions of this software include:

**Message reception and distribution** - This software component receives messages over a control channel or through an in-band channel, and distributes them to the appropriate software process for interpretation and processing.

**System information processing** - This component interprets the System Information provided by the protocol (e.g., Advanced Television Systems Committee (ATSC), or Digital Video Broadcast (DVB) standard) specifying the Modulation Type, Channel Map, Service Maps, Service Descriptions, Service Components. This information allows the software to find, reconstruct and deliver the service to the user or application.

**Configuration and control message processing** - This component interprets the configuration and control messages sent to the settop from, e.g., a cable headend controller. This information is used to provision a settop to operate within the cable television system or other applicable network. The component sets up the settop's features and provides the ability to control the settop operation remotely by the system operator.

**Digital and analog service acquisition** - This component performs all of the necessary functions to 'tune' a video/audio service to be presented to the television viewer.

**Conditional access subsystem** - this component authorizes services and applications. Video services are delivered to the settop in an encrypted form. The Conditional Access (CA) system compares authorization information about the service with authorization information that is delivered to the settop. When a service is deemed authorized, the CA system enables the

decryption of that service.

**Download subsystem** - this component acquires software objects from the cable or other applicable network and stores them in the settop's memory. These objects may  
5 include, e.g., software suites or applications. The download subsystem determines if it is authorized to accept the object and, if it is, then processes and stores each segment of the object. Once the object is stored, it is validated and can then be enabled to  
10 execute either from, e.g., the headend control, or by the operating system.

**Return path subsystem** - This component collects purchase and diagnostic information and transmits it back to the headend (or other appropriate system  
15 operator site) upon command. This information is ultimately sent to a billing system to enable billing of services used by the settop. The return path can be a store-and-forward mechanism or an on-demand interactive mechanism.

**Diagnostic Data management subsystem** - This component  
20 collects and manages data which can be used to diagnose the state of the settop, allowing for remote determination of the operation and health of the settop software. This data is made available to the OS for  
25 display to the user or installer. It is also made available to the return path subsystem for collection by a computer at the system operator's site (e.g., at a cable headend).

The CABIOS (Conditional Access Basic Services)  
30 provides conditional access services above the normal service access control, including:

**Object Authentication** - This function authenticates a

software object to determine that the object is the intended object. Such authentication is accomplished, for example, by matching a signature delivered with the object.

5    **Object Authorization** - This function authorizes objects to be loaded and executed in the settop. It uses the conditional access hardware to determine the authorization status of the settop.

10   **Resource Authorization** - This function authorizes the use of settop resources through the conditional access hardware.

15   **Baseline Privacy Key Exchange Services** - These functions support the key exchange requirements of the Cable modem system, which may conform to the Data-Over-Cable Service Interface Specifications (DOCSIS).

20   **Cryptographic Functions** - These functions provide a basic cryptographic toolkit for use by the application operating system and applications within the settop. As indicated above, a typical cryptographic tool set follows the PKCS 11 standard, although other standards can be used.

25       The graphics, audio and video subsystem 22 includes, in a preferred embodiment, two-dimensional (2D), three-dimensional (3D), and video libraries working on top of a graphics display driver. Such display drivers are commonly available from various vendors such as ATI Technologies Inc. of Thornhill, Ontario, Canada. Subsystem 22 provides a standard API to which middleware providers can be ported, and enables  
30   video to be viewed combined with graphics. More particularly, the analog or digital video is combined with a graphics overlay to present a combined view to



the user. This subsystem 22 also provides audio, which can exist in multiple modes, such as stereo and surround sound. The audio subsystem can also support record and playback of audio files.

5       The network communications stacks 24 provide standardized networking stacks to facilitate web browsing and communications with external devices. This subsystem 24 includes many standardized network protocols which can be delivered over multiple  
10       communications paths. The stacks can comprise, for example, Mentor/Microtec's CNX communications extension to the VRTX operating system, available from Mentor Graphics Corporation.

      This subsystem 24 resides on top of the  
15       communications drivers (e.g., Ethernet and DOCSIS drivers) and provides, for example, a Berkeley sockets (Berkeley Software Design, Inc.) interface to protocols such as Transmission Control Protocol (TCP)/Internet Protocol (IP) (e.g., a TCP/IP interface over a DOCSIS  
20       modem or over an Ethernet device), User Datagram Protocol (UDP), Address Resolution Protocol (ARP), Internet Control Message Protocol (ICMP), Dynamic Host Configuration Protocol (DHCP) Client, Domain Name System (DNS) Client, and Point-to-Point Protocol (PPP) (dial-up  
25       uses CCP, Link Control Protocol (LCP) and Internet Protocol Control Protocol (IPCP) protocols).

      For the settop hardware 34 to operate the settop box for its intended functions, various drivers must be provided, as well known in the art. These are depicted  
30       in the Figure as low level device drivers 32, which are interfaced to a driver model used by the core settop system software 20 via device drivers-to-driver model interface 30.

The interface 30 separates the details of the driver model environment from the core system software 20, and is used to isolate the device drivers 32 from the specifics of the driver model provided by the operating environment. The low level device driver software 32 is hardware-specific and portable across operating environments. The driver model interface 30 ties the hardware-specific device driver 32 to the OS by providing the OS's desired interface to the driver.

Device drivers are provided for each device supported on the settop. These include a graphics driver, which may be written, e.g., on an ATI Hardware Access Provider (HAP) layer available from ATI Technologies, Inc. A graphics library for use in the settop can be written on the HAP. Other typical settop device drivers include a communications driver, the tuner (e.g., a combination of the General Instrument DOCSIS tuner and Quadrature Amplitude Modulation (QAM) code), serial ports (using, e.g., an IEEE 1394 high performance serial bus), parallel ports, Ethernet ports, Universal Serial Bus (USB) ports, Light-Emitting Diodes (LEDs), Keypad and/or Keyboard drivers, a DOCSIS driver, such as the Broadcom DOCSIS driver available from Broadcom Corporation of Irvine, California, U.S.A., and a smart card driver. A smart card may be used in the settop for consumer purchasing applications such as on-line buying. Each device in the settop requires a driver function to operate.

Details of the software interface 26 (termed "GITV"), which defines the services provided to application operating systems and middleware solution providers from the core settop system software 20, are set forth below. The interface can be implemented using

any known techniques which will be apparent to those skilled in the art.

### **Software Interface Functions**

#### **1. Service Acquisition and Service Status APIs**

##### **5 1.1. Service Acquisition Overview**

Service Acquisition is the process of allowing a client to obtain downstream services. The Service Acquisition software manages the Service Acquisition process. Support is currently provided for DigiCipher II (DCII) acquisition of primary and background digital services. DCII, proprietary to the assignee hereof, is analogous to MPEG-2. Support is also provided for analog service acquisitions.

Only one primary service can be acquired at a time. A digital primary service and an analog primary service cannot both be acquired at the same time.

##### **1.2. AcquireServiceBlocking**

Used to tune a specified virtual channel number (VCN) or source identifier (ID) using the specified service path (tuner). The service acquired is the primary service in the terminal, and replaces the previously tuned primary service. The call returns a status indicating any errors encountered while servicing the API.

##### **25 1.3. AcquireServiceNonBlocking**

Used to tune a specified virtual channel number (VCN) or source ID on the specified service path. AcquireServiceNonBlocking initiates acquiring of a service but does not wait for completion of the acquisition before returning. The status returned by

the API indicates any basic errors that would prevent the API from being serviced. If the initial call did not have an error, then upon completion of the service acquisition (either by success or failure), the user-  
5 defined callback function is called, passing the user-allocated callback data structure.

#### 1.4. **GetServiceStatus**

Used to request status information on the currently tuned primary service on the specified service path.  
10 The API allocates and fills the service status structure, which includes the service path, virtual channel number, channel override status, service type, service component stream status, service acquisition status, and program status. The call returns a status  
15 indicating any errors encountered while servicing the API.

#### 1.5. **RegisterServiceStatus**

Used to register the client for unsolicited service status updates for the currently tuned primary service  
20 on the specified service path. The status returned by the API indicates any errors that would prevent the API from being serviced. If the initial call did not have an error, when the service status changes the user-defined callback function will be called, passing the  
25 user-allocated callback data structure.

#### 1.6. **CancelServiceStatus**

Used to cancel the registration for service status updates that was set up by the RegisterServiceStatus API. The call returns a status indicating any errors  
30 encountered while servicing the API.

### 1.7. GetVCTData

Used to get a summary of the current Virtual Channel Table information for all defined virtual channels in the system. The API allocates and fills the VCT data structure, which includes a record for each defined virtual channel. The call returns a status indicating any errors encountered while servicing the API.

### 1.8. GetVCTDocsisData

Used to get a summary of the current Virtual Channel Table information and characteristics for all defined DOCSIS downstream channels. DOCSIS downstream channels are defined to be any virtual channel that has a source ID equal to 23005. The API allocates and fills the VCT DOCSIS data structure, which includes a record for each defined DOCSIS channel. The call returns a status indicating any errors encountered while servicing the API. If there are no DOCSIS channels in the Virtual Channel Table, the API will return the error status value SAQERR\_VCT\_NO\_DOCSIS, and will not allocate any memory for the DOCSIS data structure.

### 1.9. SelectServiceComponent

Used to add a service component of the specified type to the primary service on the specified service path. If the component is a text or data component, the API places the connect ID for the new component in the user-allocated memory location. The call returns a status indicating any errors encountered while servicing the API.

### 1.10. DeselectServiceComponent

Used to deselect the specified component from the primary service on the specified service path. Service

components that are deselected are disabled. The call returns a status indicating any errors encountered while servicing the API.

#### 1.11. SelectServiceIPData

5       Used to select a service component that carries particular multicast IP datagrams. These datagrams are carried within Digital Video Broadcast (DVB)-Multi-Protocol Encapsulation (MPE) Datagram Section messages, which contain headers with multicast MAC (Medium Access  
10   Control) addresses that are directly related to the IP datagram's multicast IP address (see Data-Over-Cable-Service Interface Specification - DOCSIS, Baseline Privacy Interface Specification [SP-BPI-101-970922]).

15       The calling program will select the desired multicast data by specifying the multicast MAC address. This call will return a Connection ID that is placed in memory starting at the location indicated by the pointer provided as part of the call. Connection ID identifies the packet identifier (PID) stream (or streams) carrying  
20   the requested multicast data as well as the MAC address of the target DVB-MPE datagram sections. Normally, Connection ID will be directly related to the specific multicast MAC address provided as part of the call. However, a promiscuous listening mode can optionally be  
25   selected. In this mode, every data PID component carrying IP data will be identified so all IP datagram fragments may be passed to the calling program. In the Promiscuous mode, the returned Connection ID will map to all component PIDs carrying IP data, and all valid  
30   multicast MAC addresses carried within the currently tuned service.

ReadServiceIPData requires the returned Connection ID to retrieve the requested IP data. The calling

program may also specify that serving process should continue to look for the requested data, even if it does not immediately identify a target PID stream.

Alternatively, the calling program may specify that only  
5 one attempt should be made to locate the PID stream carrying the requested data. The call also returns a status indicating any errors encountered while servicing the API.

#### 1.12. ReadServiceIPData

10 Used to extract IP Datagram Fragments from DVB-MPE Datagram Sections being carried on one or more elementary PID stream components. The Connection ID passed to this API identifies the elementary PID stream component and multicast MAC address of the requested  
15 DVB-MPE datagram section. In some cases, the Connection ID will point to every datagram section being carried within the currently tuned service, regardless of its multicast MAC address. This occurs if a previous call to SelectServiceIPData was made with listenMode =  
20 "PROMISCUOUS", rather than listenMode = "NORMAL".

ReadServiceIPData returns a status as soon as the read is posted, indicating any errors encountered while servicing the API. The actual message is routed to the client by the message distribution software using the  
25 callback function and the callback data structure.

Calls to ReadServiceIPData will result in only IP datagram fragments being passed to the call back function. Thus, the DVB-MPE datagram section header and CRC trailer will be removed before passing the message  
30 (i.e., IP datagram) to the requesting client. Note that ReadServiceIPData will return, via a callback, a disconnected status if, for example, a channel change is detected.

### 1.13. DeselectServiceIPData

Used to deselect the specified stream component that was previously selected with the SelectServiceIPData call. This call does not require component ID as does the normal DeselectServiceComponent. Service components that are deselected are disabled. The call returns a status indicating any errors encountered while servicing the API.

### 10 1.14. PostComponentRead

Used to request a message from a text or data-service component that was previously selected using the SelectServiceComponent API. The user specifies the connection ID of the text or data-service component. The PostComponentRead returns a status as soon as the read is posted, indicating any errors encountered while servicing the API, and the actual message is routed to the client by the message distribution software, using the callback function and the callback data structure.

### 20 1.15. AcquireBackgroundServiceBlocking

Used to acquire downstream data from the specified service source. The passed array of multicast 16 addresses allows the user to specify the multicast addressed groups to receive messages for. The API places the correct ID for the new service in the user-allocated memory location. The call returns a status indicating any errors encountered while servicing the API.

### 1.16. AcquireBackgroundServiceNonBlocking

30 Used to acquire downstream data from the specified service source. The passed array of multicast 16 addresses allows the user to specify the multicast



addressed groups to receive messages for.

AcquireBackgroundServiceNonBlocking initiates acquiring of a service but does not wait for completion of the acquisition before returning. The API places the  
5 connect ID for the new service in the user-allocated memory location. The acknowledge response returned by the API indicates basic errors that would prevent the API from being serviced. If the initial call did not have an error then upon completion of the service  
10 acquisition (either by success or failure) the user defined callback function will be called, passing the user-allocated callback data structure.

#### 1.17. ReleaseBackgroundService

Used to release access to downstream data from the  
15 specified service connection. The call returns a status indicating any errors encountered while servicing the API.

#### 1.18. PostBackgroundRead

Used to receive data or text from the specified  
20 background service connection that was previously acquired using the AcquireBackgroundServiceBlocking or AcquireBackgroundServiceNonBlocking API. PostBackgroundRead returns a status as soon as the read is posted, indicating any errors encountered while  
25 servicing the API, and the actual message is routed to the client by the message distribution software, using the callback function and the callback data structure.

#### 1.19. SourceIDtoVCN

Used to obtain the virtual channel number(s)  
30 associated with the specified SourceID. If there are multiple VCNs associated with a single source ID, the complete list of associated VCNs is returned. A

successful call will fill in the API allocated structure, which includes the number of VCNs actually associated with the VCN, the number of VCN/service type pairs actually returned for the call, and the actual VCN and service type (analog vs. digital) for each of the VCNs defined. The API will assign the passed pointer to the allocated structure. The call returns a status indicating any errors encountered while servicing the API.

#### 10           1.20.   VCNtoSourceID

Used to obtain the Source ID associated with the specified VCN. A successful call will fill in the user allocated SourceID parameter. There is only a single source ID associated with a VCN. The call returns a status indicating any errors encountered while servicing the API.

#### 1.21.   PendingVCTChange

Used to obtain a list of pending changes to the Virtual Channel Table (VCT), from the specified (GPS-Global Positioning Satellite) time forward. A successful call will fill in the API allocated structure with the pending VCT changes and assign the passed pointer to the allocated structure. Each pending change includes the Virtual Channel Number, Service Source ID, and the Global Positioning System (GPS) time indicating when the change to the VCT is scheduled to occur. The call returns a status indicating any errors encountered while servicing the API.

#### 1.22.   GetDCBM

30           Used to obtain the Defined Channel Bit Map (DCBM) for the specified channel type. The DCBM is a bit-map that represents the currently defined virtual channels

(services). A successful call will fill in the user allocated DCBM array. This list of defined channels is provided as a packed array of bits, with one bit location per service. A bit value of 1 represents a defined channel, 0 represents not defined. The call returns a status indicating any errors encountered while servicing the API.

#### 1.23. ServiceComponentSplice

Used to identify the next audio and/or video components for a service, and to determine whether audio and/or video are to be switched.

#### 1.24. AppIDtoVCN

Used to obtain the virtual channel number associated with the specified application ID. A successful call will fill in the user allocated pVcn parameter (a pointer to VCN information). There is only a single VCN associated with an application ID. The call returns a status indicating any errors encountered while servicing the API.

#### 1.25. VCNtoAppID

Used to obtain the application ID associated with the specified VCN. A successful call will fill in the user allocated application ID parameter. There is only a single application ID associated with a VCN. The call returns a status indicating any errors encountered while servicing the API.

#### 1.26. SourceNameToAppID

Used to obtain the application ID associated with the specified source name string. A successful call will fill in the user allocated pAppID parameter (a pointer to where to place the application ID). There is only a single application associated with a source name string.

The call returns a status indicating any errors encountered while servicing the API.

### 1.27. AppIDtoSourceName

Used to obtain the source name string ID associated with the specified application ID. A successful call will fill in the API allocated source name string parameter and the user allocated name length parameter. There is only a single source name string associated with an application ID. The call returns a status indicating any errors encountered while servicing the API.

## 2. System APIs

### 2.1. SysRequestConfiguration

Used to get the current terminal configuration. The call returns a status indicating any errors encountered while servicing the API.

### 2.2. SysRequestEPGConfig

Used to get the following Electronic Program Guide (EPG) information:

- Group Assignment Configuration - A list of current Group Assignments. Group Assignments provide a means of assigning a settop to a particular application group.
- Currency Region Configuration - Defines the currency region. The currency region can be used to define different cost regions.
- EPG Region Configuration - Specifies the logical location of the DCT, from the application's perspective.
- Preferred Language - The current preferred language.

The call returns a status indicating any errors encountered while servicing the API.

### 2.3. **SysRequestStatus**

Used to get the current converter system status.  
5 The call returns a status indicating any errors encountered while servicing the API.

### 2.4. **SysRequestTimestamp**

Used to get a system timestamp with local time to the second, current date, time zone information, etc.  
10 The call returns a status indicating any errors encountered while servicing the API.

### 2.5. **SysTimestampRegister**

Used to register the client for unsolicited system timestamp updates. The system timestamp indicates local  
15 time to the second, including the current date, day of the week, time zone information, etc. The system timestamp is received from the headend and forwarded asynchronously to the client. The status returned by the API indicates any errors that would prevent the API  
20 from being serviced. If the initial call did not have an error, then whenever a new system timestamp is received, the user defined callback function will be called, passing the user-allocated callback data structure.

### 25 2.6. **SysTimestampCancel**

Used to cancel the registration for system time updates that was set up by the SysTimestampRegister API. The call returns a status indicating any errors encountered while servicing the API.

### 30 2.7. **SysSetRFOutChannel**

Used to set the output channel number for the radio frequency (RF) modulator hardware. The call returns a

status indicating any errors encountered while servicing the API.

#### 2.8. SysControlOnOffState

Used to set the terminal to the On or Off state.

5 The call returns a status indicating any errors encountered while servicing the API.

#### 2.9. SysControlACRelay

Used to switch between the different utility outlet modes. The terminal features the ability to control the operation of a utility outlet between switched (automatic mode) control and continuous force on / continuous force off modes. When the terminal is in the automatic mode, the utility outlet will be powered while the terminal is in the ON state and unpowered while the terminal is in the OFF state. The manual operation modes allow the application to set the utility (U.S. type) outlet ON continuously or OFF continuously. The call returns a status indicating any errors encountered while servicing the API.

#### 20 2.10. SysControlRFBypass

Used to select whether the RF signal is routed through the terminal or bypasses the terminal. This feature allows more friendly operations with cable-ready TVs and VCRs. The feature duplicates the TV/VCR switch found in many VCRs. The act of turning OFF the terminal will force the bypass condition. The cable operator may override the selected state. The actual state can be determined using SysRequestStatus(). The call returns a status indicating any errors encountered while servicing the API.

30

### **2.11. SysSetLanguage**

Used to set the consumer's preferred language. The call returns a status indicating any errors encountered while servicing the API.

## **5 3. Unsolicited Event Indication APIs**

### **3.1. UsoleventRegister**

Used to register clients for unsolicited event indication messages. The status returned by the API indicates any errors that would prevent the API from being serviced. If the initial call did not have an error, then whenever a new event occurs for which a client is registered, the user defined callback function will be called, passing the user-allocated callback data structure.

### **15 3.2. UsoleventCancel**

Used to cancel the registration for an unsolicited event indication that was set up by the UsoleventRegister API. The call returns a status indicating any errors encountered while servicing the API.

## **4. Baseline Privacy Interface APIs**

### **4.1. Purpose & Scope**

This section is intended to define a BPI cryptographic services interface by defining a set of API functions to support BPI key management (BPKM) protocol for a DOCSIS driver. These APIs shall not be responsible for the implementation of Authorization and Traffic Encryption Key (TEK) state machines in BPKM.

### **4.2. Security Objectives and Goals**

API functions are defined to provide cryptographic

services for the above-mentioned two state machines only. The cryptographic services shall include the following:

- 5       • Provide Cable Modem's RSA public key to the DOCSIS Driver.
- Perform RSA decryption operation on encrypted Authorization Key provided by DOCSIS Driver. There are two independent modes in which the GI BPI APIs can be included into the code.
- 10       ➤ Shall return decrypted Authorization Key to the DOCSIS Driver if DOCSIS Driver has capability of deriving all of the necessary remaining keys. If this mode is selected, only two BPI APIs need to be included in the code (CMExportID, CMAuthKey).
- 15       ➤ Shall not return decrypted Authorization Key to the DOCSIS Driver. If this mode is selected, then five BPI APIs need to be included in the code (CMExportID, CMDeriveKeys, CMGenerateHMAC, CMVerifyHMAC, CMDecryptTEK).
- 20       • Generate Key Encryption Key (KEK) based on the decrypted Authorization Key, but shall not return KEK to the DOCSIS Driver.
- Generate upstream hashed-based message authentication code (HMAC) Key, but shall not return the upstream HMAC key to the DOCSIS Driver.
- 25       • Authenticate the Key Request message, and return the upstream HMAC keyed message digest to the DOCSIS Driver.
- Generate downstream hashed-based message authentication code (HMAC) Key, but shall not return the downstream HMAC key to the DOCSIS Driver. Validate the downstream HMAC using the downstream HMAC key.
- 30



- Decrypt DES encrypted Traffic Encryption Key (TEK) using KEK, and return TEK to the DOCSIS Driver.

#### 4.3. Definitions, Acronyms, Abbreviations

	BPI	Baseline Privacy Interface
5	BPKM	Baseline Privacy Key Management protocol
	CM	Cable Modem
	CMTS	Cable Modem Termination System
	CBC	Cipher Block Chaining
	CSP	Interface Cryptographic Service Provider
10	DES	Data Encryption Standard algorithm (FIPS-46, FIPS-46-1, FIPS-74, FIPS-81)
	DOCSS	Data Over Cable Security System
	DOCSIS	Data Over Cable Service Interface Specifications
15	HMAC	Hashed-based Message Authentication Code
	KEK	Key Encryption Key
	RSA	Rivest Shamir Adleman, public key encryption technique
	SHA	Secure Hash Algorithm
20	SID	Service Identification
	TEK	Traffic Encryption Key

#### 4.4. Message Support Functions

##### **CExportID**

Used to export CM-Identification attributes from the BPI Cryptographic Service Provider (CSP). CM-  
25 Identification attributes are used in Authorization Request and Key Request messages.

##### **CMAuthKey**

Used to decrypt the Authorization Key (Auth Key) sent in the Authorization Reply message, and then pass the decrypted Auth Key back to the caller. This  
30 function shall be called by the DOCSIS Driver

immediately when a Authorization Reply message is received from a CMTS. If the calling entity uses this API then the calling entity will be required to derive the Key Encryption Key (KEK), upstream HMAC key (HMAC\_KEY\_U), and downstream HMAC key (HMAC\_KEY\_D). This API will be used in the WinCE based ASTB. The determination of whether to include this API or the CMDeriveKeys API will be determined by the customer requirements. Based on these requirements, one or the other API will be part of the compile for that systems software build.

#### **CMDeriveKeys**

Used to derive the Authorization Key (Auth Key), the Key Encryption Key (KEK), upstream HMAC key (HMAC\_KEY\_U), and downstream HMAC key (HMAC\_KEY\_D). This function shall be called by the DOCSIS Driver immediately when a Authorization Reply message is received from a CMTS. The BPI CSP shall maintain a single active authorization key and associated derived keys. Auth Key, KEK, HMAC\_KEY\_U, and HMAC\_KEY\_D shall not be available to DOCSIS Driver. This API shall be used when the DOCSIS driver does not have the capability to derive all of the needed keys from the Auth Key.

#### **CMGenerateHMAC**

Used to generate a keyed message digest (HMAC-Digest) for the Key Request message (an upstream message from CM to CMTS), as defined in BPI Spec. HMAC-Digest shall be returned to the DOCSIS Driver.

#### **CMVerifyHMAC**

Used for CM to authenticate the Key Reply, Key Reject, and TEK Invalid message.

#### **CMDecryptTEK**

Used for CM to decrypt the TEK-Key sub-attribute in a SA-Parameters attribute, as defined in section 4.2.1.5 of BPI Spec. This API will only produce one clear TEK each time it is accessed. In order for the Cable Modem (CM) to meet the requirement to have the primary and the secondary TEK available the DOCSIS driver will need to make this API call twice. The DOCSIS driver shall keep track of which call to the API is for the primary TEK and which call is for the secondary TEK.

## 10           5.    Downloader APIs

### 5.1.    Overview

The Downloader provides an API for applications and the App OS to manage objects loaded into the DCT5000 either from the head-end or via API calls.

### 15           5.2.    FindFirstObject

Used to search for a currently loaded object and return information about it. It can be used in conjunction with the FindNextObject API to search the object directory for all objects matching specified criteria. The call returns a status indicating any errors encountered while servicing the API.

### 5.3.    FindNextObject

Used to search for the next currently loaded object and return information about it. It is used in conjunction with the FindFirstObject API to search the object directory for all objects matching specified criteria. The FindFirstObject call must have returned a successful result before this call can be used to continue a search. All parameters specified on the FindNextObject must match those from the previous FindNextObject or the FindFirstObject call. Once a not

found condition is returned, a FindFirstObject must be used to start a new search. This call returns a status indicating any errors encountered while servicing the API.

5           **5.4. RegisterObjectManager**

Used by the App OS to register as the manager for managed objects. The Downloader will notify the object manager via a callback whenever a managed object's state changes or is requested to change (e.g., delete message from head-end). The call returns a status indicating any errors encountered while servicing the API.

**5.5. WriteCompleteObject**

Used to create and write an object in one atomic operation. This is useful when the object has been completely loaded into a memory buffer. The call returns a status indicating any errors encountered while servicing the API.

**5.6. CreateObject**

Used to prepare for an object to be written to memory, including allocating space for it. This is useful for creating an object when all the data for the object is not presently available in memory (see WriteCompleteObject). The call returns a status indicating any errors encountered while servicing the API.

The combination of CreateObject, WriteObject, and CloseObject can be used to create an object that is not available all at once to be written in a single write operation (as with WriteCompleteObject). The caller is responsible for tracking the areas of the object that have been written to. If a CloseObject is issued before all parts of the object have been written, the contents

of unwritten portions of the object may contain random values (i.e., no attempt is made by WriteObject to track what areas have been written to). If an attempt is made to write new data over data already written with a  
5 previous WriteObject, either the new data will be successfully stored over the old data (if in RAM) or a write error will occur (if in flash memory).

#### 5.7. WriteObject

Used write a portion of an object to memory. The  
10 call returns a status indicating any errors encountered while servicing the API.

#### 5.8. CloseObject

Used to terminate writing to object memory for a specified object. The call returns a status indicating  
15 any errors encountered while servicing the API.

#### 5.9. ReadObject

Used to obtain the contents of the specified object. The call returns a status indicating any errors encountered while servicing the API.

#### 20 5.10. DeleteObject

Used to remove one or more objects from memory. The call returns a status indicating any errors encountered while servicing the API.

#### 5.11. PurgeObject

25 Used to remove one or more objects from memory. The call returns a status indicating any errors encountered while servicing the API.

#### 5.12. Callback Functions

##### Object Manager Callback

The object manager may receive callbacks from the  
30 Downloader, depending on activity that occurs in the DCT5000 related to downloaded objects. When a

significant event occurs, the object manager is called with a pointer to the callback structure that identifies the event and the object to which the event applies. Callbacks are issued as events occur, so there may be more than one outstanding callback at any given time. The structure is both allocated and deallocated by the Downloader.

## **6. Purchase and Authorization APIs**

### **6.1. PurchaseProgramImmediate**

Requests that the program on the currently tuned VCN be purchased. The specified VCN must match the currently tuned VCN, and ServiceStatus should indicate that the program is purchasable.

### **6.2. PurchaseProgram**

Requests that the program on the currently tuned VCN be purchased. The specified VCN must match the currently tuned VCN, and ServiceStatus should indicate that the program is purchasable.

### **6.3. CancelProgramPurchase**

Requests that the purchase of the specified program be canceled. The cancel ID and the VCN are required to cancel a previously purchased program. It is not necessary to be tuned to the specified VCN in order to cancel a purchase. The cancel ID is used to uniquely identify the purchase to be canceled, and the VCN is used as a secondary cross-reference. Note that the purchase must be "cancelable" for the request to be fulfilled. A purchase is cancelable if the time of the cancellation falls within the Cancelable Window and the headend has configured the terminal to allow canceling. The Cancelable Window is defined (approximately) as the

time between the start of the Interactive Pay Per View (IPPV) window and the end of the free preview (i.e., IPPV start + free preview duration).

#### 6.4. PurchasePackageImmediate

5 Requests that the program package indicated by the PackageName on the currently tuned VCN be purchased. The specified VCN must match the currently tuned VCN, and ServiceStatus should indicate that the package is purchasable.

#### 10 6.5. PurchasePackage

Requests that the program package indicated by the PackageName on the currently tuned VCN be purchased. The specified VCN must match the currently tuned VCN, and ServiceStatus should indicate that the package is  
15 purchasable.

#### 6.6. CancelPackagePurchase

Requests that the purchase of the specified packaged service be canceled. The cancel ID and the VCN are required to cancel a previously purchased program.  
20 It is not necessary to be tuned to the specified VCN in order to cancel a purchase. The cancel ID is used to uniquely identify the purchase to be canceled, and the VCN is used as a secondary cross-reference. Note that the purchase must be "cancelable" for the request to be  
25 fulfilled. A purchase is cancelable if the time of cancellation falls within the Cancelable Window and the headend has configured the terminal to allow canceling. The Cancelable Window is defined (approximately) as the time between the start of the IPPV window and the end of  
30 the free preview (i.e. IPPV start + free preview duration).

### 6.7. GetPendingPurchases

Requests all purchases that are pending.

Typically, this function is utilized following system start-up to determine what purchases are outstanding.

5 The user can then provide a callback function for each pending purchase using the PurchaseCallbackRefresh API. This API provides purchases of all types, including analog programs, digital programs and digital packages. Only certain parameters are valid in each case.

### 10 6.8. PurchaseCallbackRefresh

This API is utilized by the user, following system start-up, to refresh the purchase callback function pointer for a specified program or package purchase.

## 7. Password APIs

### 15 7.1. SettopSetPassword

Sets the password for indicated slot. Password slot PARENTAL\_PASSWORD is used for the Parental Control password and slot PURCHASE\_PASSWORD for purchasing. Additional slots may be provided for generic passwords, depending on the terminal model. A password is an array of PASSWORD\_LENGTH characters. The call returns a status indicating any errors encountered while servicing the API.

### 7.2. SettopCheckPassword

25 Verifies the indicated password for a particular slot. Password slot PARENTAL\_PASSWORD is used for the Parental Control password and slot PURCHASE\_PASSWORD for purchasing. Additional slots may be provided for generic passwords, depending on the terminal model. If  
30 the password has been cleared or never been set, any password will match. The call returns a status



indicating any errors encountered while servicing the API.

## **8. Initialization APIs**

### **8.1. StartGITV**

5 Starts GITV. The application operating system is the external client that interfaces to this API. The call returns a status indicating any errors encountered while servicing the API.

### **8.2. IsGITVReady**

10 Verifies GITV is running. The application operating system is the external client that interfaces to this API. The call returns a status indicating any errors encountered while servicing the API.

## **9. Platform Configuration APIs**

### **9.1. GetSDRAMInfo**

15 Checks the validity of SDRAM, returning the starting address, size and validity of the SDRAM installed in the settop. The call returns a status indicating any errors encountered while servicing the API.

### **9.2. GetEndianStatus**

Returns the ENDIANness of the CPU at initialization.

### **9.3. GetNVMEMInfo**

25 Checks the validity of NVMEM, returning the starting address, size and validity of the NVMEM installed in the settop. The call returns a status indicating any errors encountered while servicing the API.

#### 9.4. GetSettopIDs

Retrieves information about the settop including the Platform ID, Manufacturer, Family and Model information. The call returns a status indicating any errors encountered while servicing the API.

#### 9.5. GetTSIInfo

Retrieves the processor, bridge type and crystal speeds for the settop, in addition to the MAC addresses for DOCSIS, Ethernet, 1394, USB, and Settop. The call returns a status indicating any errors encountered while servicing the API.

#### 9.6. GetMemoryInfo

Retrieves memory size information for miscellaneous memory components of the settop. The call returns a status indicating any errors encountered while servicing the API.

#### 9.7. GetCableModemInfo

Retrieves cable modem and DOCSIS option information. The call returns a status indicating any errors encountered while servicing the API.

#### 9.8. GetMiscellaneousInfo

Retrieves the type of output channel in use by the settop. The call returns a status indicating any errors encountered while servicing the API.

#### 9.9. Get1394Info

Retrieves information about the 1394 interface installed in the settop. The call returns a status indicating any errors encountered while servicing the API.

#### 9.10. GetEthernetInfo

Retrieves information about the Ethernet interface installed in the settop. The call returns a status

indicating any errors encountered while servicing the API.

#### **9.11. GetParallelPortInfo**

Retrieves information on the parallel port  
5 installed in the settop. The call returns a status indicating any errors encountered while servicing the API.

#### **9.12. GetHardDriveInfo**

Retrieves the type of hard drive currently  
10 installed in the settop. The call returns a status indicating any errors encountered while servicing the API.

#### **9.13. GetPlatformInfo**

Retrieves the type of platform and the version of  
15 the platform currently running in the settop. The call returns a status indicating any errors encountered while servicing the API.

### **10. Diagnostic APIs**

#### **10.1. GetErrorStatus**

20 Indicates the type of error when an error has occurred. Since the settop could be one of the following: Bootloader, Base Platform or Native Suite, the coding scheme and interpretation may differ per platform. This API does not support the Bootloader  
25 error codes. These can be found in the Start-up Database. This call returns a status indicating any errors encountered while servicing the API.

#### **10.2. GetPurchasesStatus**

The GetPurchaseStatusdiagnostic contains  
30 information related to IPPV purchases in the settop. This call returns a status indicating any errors

encountered while servicing the API.

### 10.3. GetOutputPortStatus

The output port status contains information related to the terminal output or re-modulated (Remod) port.

5 The output / Remod port is the interface from the terminal to the subscriber's television set. This call returns a status indicating any errors encountered while servicing the API.

### 10.4. GetLastReset

10 The GetLastReset indicates the last reset time in GPS seconds, the type of reset that occurred and the last Fatal Error Log entry.

### 10.5. GetVCTID

15 Indicates the VCT ID for the virtual channel table that is resident in the settop.

### 10.6. GetOOBStatus

Indicates the status of the OOB stream components. This call returns a status indicating any errors encountered while servicing the API.

20 10.7. GetInbandStatus

Indicates the status of the current INBAND multiplex.

### 10.8. GetUnitAddresses

25 Indicates the unit addresses assigned to the settop. This call returns a status indicating any errors encountered while servicing the API.

### 10.9. GetCurrentChannelStatus

Indicates the status of the last attempted primary service acquisition.

30 10.10. GetRenewableSecurityStatus

The concept of Renewable security changes to

support DES decryption or the original Conditional Access. The renewable security slot has a PCMCIA Type II form factor, contains 2 MB secure non-volatile memory, supports cryptographic on-board key generation and encryption and DES decryption rate of 80 Mbps.

#### 10.11. GetRFModemStatus

Indicates the transmission status of the RF modem installed in the settop. This call returns a status indicating any errors encountered while servicing the API.

#### 10.12. GetCodeModuleStatus

Indicates the status for any firmware loaded into flash memory and all versions of non-volatile code that is installed in the settop.

#### 10.13. GetMemoryStatus

Indicates the memory configuration for the settop. This call returns a status indicating any errors encountered while servicing the API.

#### 10.14. GetDOCSISStatus

This API is used to retrieve DOCSIS diagnostics information from the AppOS for On Screen Diagnostics or reportback. The call returns a status indicating any errors encountered while servicing the API.

#### 10.15. GetUSBStatus

Returns status of the USB port and any installed devices. The call returns a status indicating any errors encountered while servicing the API.

#### 10.16. Get1394Status

Returns status of the 1394 port. The call returns a status indicating any errors encountered while servicing the API.

**10.17. GetEthernetStatus**

Returns status of the Ethernet port. The call returns a status indicating any errors encountered while servicing the API.

5      **10.18. GetParallelStatus**

Returns status of the Parallel port. The call returns a status indicating any errors encountered while servicing the API.

**10.19. GetIRBlasterStatus**

10      Returns status of the IR blaster (transmitter).  
The call returns a status indicating any errors encountered while servicing the API.

**10.20. GetIRKeyboardStatus**

15      Returns status of the IR keyboard. This call  
returns a status indicating any errors encountered while servicing the API.

**10.21. GetIRRemoteStatus**

20      Returns status of the IR remote. The call returns  
a status indicating any errors encountered while servicing the API.

**10.22. GetSmartCardStatus**

Returns status of the Smart Card. The call returns a status indicating any errors encountered while servicing the API.

25      **10.23. GetHardDriveStatus**

Returns status of the hard drive. The call returns a status indicating any errors encountered while servicing the API.

**10.24. GetSettopGraphicsStatus**

30      Returns status of the settop graphics system. The  
call returns a status indicating any errors encountered

while servicing the API.

#### **10.25. GetNetworkAdapterStatus**

Indicates whether a network adapter is available in addition to associated parameters and/or status.

#### **5 10.26. GetResourceAuthorizationStatus**

This API returns the Resource Authorization status for each resource in the settop.

#### **10.27. GetMPEGLockStatus**

10 This API returns the lock status of the MPEG video and audio streams, as well as the Program Clock Reference (PCR).

### **11. Audio Server APIs**

#### **11.1. AudioControlModeSelect**

15 The Audio Control Mode Select API call allows a client to set the DCT5000's Audio Output Mode. Selections include: Surround, Stereo, and Mono.

#### **11.2. AudioControlVolumeModeSelect**

20 The Audio Control Volume Mode Select API call allows a client to set or adjust GITV's Volume Unit definition. This API call is independent of service type, Analog or Digital.

#### **11.3. AudioControlLoopThruSelect**

25 The Audio Loop Thru Control API call allows a client to enable or disable Audio Loop Thru.

- Loop Thru Enabled (On): Settop outputs the external audio source on the baseband connectors.
- Loop Thru Disable (Off): Settop mutes the external audio source.

#### **11.4. AudioControlAC3CompressionSelect**

30 The AC-3 Compression Control API call allows a

client to set the AC-3 Dynamic Range Compression Mode:  
No Compression, Light Compression or Heavy Compression.

#### 11.5. AudioControlSAPSelect

5 The SAP Selection API call allows a client to  
select the Secondary Audio Program (SAP) Audio Source  
within an Analog Service, if available. This operation  
only applies to a single Analog Service. Specifically,  
the settop only allows SAP to be selected while acquired  
or tuned to an Analog Service with SAP.

#### 10 11.6. AudioControlSPDIFSelect

The Sony Philips Digital Interface Format (SPDIF)  
Selection API call allows a client to select the  
settop's SPDIF or Digital Audio Output path over the  
Analog Audio Output paths (remod and baseband).

15 The settop provides three SPDIF output modes:

- SPDIF Enabled: Settop outputs audio over  
SPDIF, baseband and remod audio is unavailable. Audio  
output formats include: downmixed surround (l+r),  
stereo, and mono.
- 20 - SPDIF Enabled with Full AC-3 Output: Settop  
outputs AC-3 directly over SPDIF. AC-3 output only  
applies the Digital Services. Stereo or Mono output for  
Analog Services over SPDIF. Requires an AC-3 decoder  
downstream from the settop.
- 25 - SPDIF Disabled: Settop outputs audio over  
the Analog Output paths (remod, and baseband). Audio  
output formats include: downmixed surround (l+r),  
stereo, and mono.

#### 11.7. AudioVolume (Basic Control)

30 This API call allows a client to adjust the  
settop's master audio volume. The settop adjusts both  
the left and right channel outputs.



**11.8. AudioVolumeBalance (Balance Control)**

This API call allows a client to adjust the settop's master audio volume with separate left and right channel values.

**5        11.9. AudioMute**

Select master Audio Mute mode on or off.

**11.10. AudioTvVolume (Basic Control)**

This API call allows a client to adjust the relative volume of TV audio sources. This call adjusts  
10 both the left and right channel outputs.

**11.11. AudioTvVolumeBalance (Balance Control)**

The TV Balance Volume Control API call allows a client to adjust the relative volume of TV audio sources with separate left and right channel values.

**15        11.12. AudioTvMute**

Select TV Audio Mute mode on or off.

**11.13. AudioLocalVolume (Basic Control)**

This API call allows a client to adjust the relative volume of local audio sources (PCM, wave, etc.). This call adjusts both the left and right  
20 channel outputs.

**11.14. AudioLocalVolumeBalance (Balance Control)**

This API call allows a client to adjust the relative volume of local audio sources (PCM, wave, etc.)  
25 with separate left and right channel values.

**11.15. AudioLocalMute**

Select Local Audio Mute mode on or off.

**11.16. AudioStatus**

The GITV Audio Server provides a single API call to  
30 report Audio Status.

## **12. Video Server APIs**

### **12.1. VideoTvBlank**

Select TV Video Blank mode on or off.

### **12.2. VideoControlTvBlankModeSelect**

5        This API call controls how the TV video is blanked by the settop. The default values are defined so that the video operates as it did before the call was introduced.

### **12.3. VideoStatus**

10       The GITV Video Server provides a single API call to report Video Status.

## **13. Resource Authorizations**

### **13.1. ResourcePermissionCheck**

Used to obtain the permission status of a resource.  
15    When used in the Global mode, the API takes the resourceID as an input parameter and attempts to lookup the ID in the resource/tier/status table. If the ID is found, the permission status is returned to the caller. If the ID is not found or a table does not exist, the  
20    API will return an error. If the API is to be used in the Application mode, the caller must include the Object ID and the Object version pointer as additional input parameters. In this case the API will verify the Global access for the ASTB as well as verify that the Object  
25    has access to the resource.

### **13.2. ResAuthStatusRegister**

Used to register the client to receive a notification if the authorization status of a resource changes. The status returned by the API indicates any  
30    errors that would prevent the API from being serviced. Once registered for a particular resource, whenever the

authorization status for that resource changes, the user will be notified using the callback mechanism.

### 13.3. ResAuthStatusCancel

5 Used to cancel the registration for a resource authorization status indication that was set up by the ResAuthStatusRegister API. The call returns a status indicating any errors encountered while servicing the API.

## 14. High Definition Passthrough APIs

### 10 14.1. GITV\_Get13945CData

This function is called to obtain the block of protected flash data containing the DTCP data.

### 14.2. GITV\_Set1394NVRAMData

15 This function is called to write the block of non-volatile random access memory (NVRAM) data containing the DTCP data.

### 14.3. GITV\_Get1394NVRAMData

This function is called to read the block of NVRAM data containing the DTCP data.

### 20 14.4. GITV\_GetTextDescriptor

Provides an alphanumeric description of the settop on the 1394 bus.

### 14.5. GITV\_DTVConnectStatus

Defines the current state of the DTV connection.

### 25 14.6. GITV\_Get13945CSRM

This function is called to obtain the 1394 5C SRM (System Renewability Message(s)). These messages contain certificate revocation lists of devices that are no longer 5C compliant. This is used to ensure the  
30 long-term integrity of the system. The SRM format is

described in chapter 7 of the 1394 5C specification  
"Digital Transmission Content Protection Specification"  
Volume 1, Revision 1.0 dated 4/12/99.

5 It should now be appreciated that the present  
invention provides a software interface that enables  
television settop middleware and operating system (OS)  
software to control and interact with core settop system  
software in a subscriber television terminal to  
10 facilitate the provision of desirable digital television  
services, including service acquisition (e.g.,  
acquisition of a pay-per-view movie), system information  
management, settop configuration and control, return  
path for polling, download capability including  
15 authentication and authorization, and non-volatile  
memory management.

Moreover, the software interface is operable in an  
architecture that enables core settop software to be  
compatible with multiple settop operating environments.  
With this software architecture, it is not necessary to  
20 port the core software to different operating  
environments by rewriting code specific to each  
environment or through an abstraction layer. Instead, a  
unique device drivers-to-driver model interface is  
provided together with a kernel abstraction component  
25 that overcomes portability issues and provides for a  
clean interface between layers in the architecture.

The invention can be implemented using object  
oriented techniques, such as C++ or Java programming,  
although the invention is by no means limited to such an  
30 implementation.

The combination of the components described herein  
provides a basis for settop software to enable advanced

features of an advanced settop box implementation. Each of the components provides necessary functions required by an advanced settop terminal. The novel architecture of the invention provides the benefits of reuse and portability of the core settop software to alternate operating environments, thereby allowing well-understood and previously tested software components to be reused. The architecture also allows implementations in alternate operating environments to be quickly and straightforwardly provided.

Although the invention has been described in connection with various specific implementations, it should be appreciated that various adaptations and modifications can be made thereto without departing from the scope of the invention as set forth in the claims.

What is claimed is:

1. An interface to core system software in a user terminal, comprising:  
a computer readable medium having computer program code; and  
means for executing said computer program code to provide at least one application program interface (API) to enable middleware that mediates between an application program and the core system software to access a function of the terminal.
2. The interface of claim 1, wherein:  
the function of the terminal comprises acquiring a service.
3. The interface of claim 1, wherein:  
the function of the terminal comprises acquiring a service by tuning a specified virtual channel number or source ID using a specified service path.
4. The interface of claim 1, wherein:  
the function of the terminal comprises determining the status of a service.
5. The interface of claim 1, wherein:  
the function of the terminal comprises requesting status information regarding a currently-tuned primary service on a specified service path.
6. The interface of claim 1, wherein:  
the function of the terminal comprises registering a client for unsolicited service status updates for a

currently tuned primary service on a specified service path.

7. The interface of claim 1, wherein:  
the function of the terminal comprises canceling a registration for service status updates that was previously set up.

8. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a summary of current Virtual Channel Table information for all defined virtual channels.

9. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a summary of current Virtual Channel Table information and characteristics for all defined DOCSIS downstream channels.

10. The interface of claim 1, wherein:  
the function of the terminal comprises adding a service component of a specified type to a primary service on a specified service path.

11. The interface of claim 1, wherein:  
the function of the terminal comprises deselecting a specified component from a primary service on a specified service path.

12. The interface of claim 1, wherein:  
the function of the terminal comprises selecting a service component that carries particular multicast datagrams.

13. The interface of claim 1, wherein:  
the function of the terminal comprises extracting datagram fragments from datagram sections being carried on one or more elementary PID stream components.

14. The interface of claim 1, wherein:  
the function of the terminal comprises deselecting a specified stream component that was previously selected.

15. The interface of claim 1, wherein:  
the function of the terminal comprises requesting a message from a text or data-service component that was previously selected

16. The interface of claim 1, wherein:  
the function of the terminal comprises at least one of:  
acquiring downstream data from a specified service source; and  
releasing access to downstream data from a specified service connection.

17. The interface of claim 1, wherein:  
the function of the terminal comprises receiving data or text from a specified background service connection that was previously acquired.

18. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining at least one virtual channel number associated with a specified source identifier



19. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a source identifier associated with a specified virtual channel number.

20. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a list of pending changes to a Virtual Channel Table.

21. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a Defined Channel Bit Map (DCBM) for a specified channel type that represents currently defined virtual channels/services.

22. The interface of claim 1, wherein:  
the function of the terminal comprises identifying a next audio and/or video component for a service.

23. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a virtual channel number associated with a specified application identifier.

24. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining an application identifier associated with a specified Virtual Channel Number.

25. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining an application identifier associated with a specified

source name string.

26. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining a source name string identifier associated with a specified application ID.

27. The interface of claim 1, wherein:  
the function of the terminal comprises managing a configuration of the terminal.

28. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining at least one of:  
current terminal configuration information;  
Electronic Program Guide (EPG) information;  
current converter system status; and  
a system timestamp with local time.

29. The interface of claim 1, wherein:  
the function of the terminal comprises at least one of:  
registering a client for unsolicited system timestamp updates; and  
canceling a registration for system timestamp updates.

30. The interface of claim 1, wherein:  
the function of the terminal comprises setting an output channel number for RF modulator hardware.

31. The interface of claim 1, wherein:  
the function of the terminal comprises setting the

terminal to an On or Off state.

32. The interface of claim 1, wherein:  
the function of the terminal comprises switching  
between different utility outlet modes.

33. The interface of claim 1, wherein:  
the function of the terminal comprises selecting  
whether an RF signal is routed through the terminal or  
bypasses the terminal.

34. The interface of claim 1, wherein:  
the function of the terminal comprises setting a  
consumer's preferred language.

35. The interface of claim 1, wherein:  
the function of the terminal comprises indicating  
an unsolicited event.

36. The interface of claim 1, wherein:  
the function of the terminal comprises at least one  
of:  
registering a client for unsolicited event  
indication messages; and  
canceling a registration for unsolicited event  
indication messages.

37. The interface of claim 1, wherein:  
the function of the terminal comprises managing  
privacy.

38. The interface of claim 1, wherein:  
the function of the terminal comprises at least one

of:

- providing a Cable Modem's public key to a DOCSIS Driver;

- performing decryption operations on an encrypted Authorization Key provided by a DOCSIS Driver;

- generating a Key Encryption Key (KEK) based on a decrypted Authorization Key;

- generating an upstream hashed-based message authentication code (HMAC) Key;

- authenticating a Key Request message, and return an upstream hashed-based message authentication code (HMAC) keyed message digest to a DOCSIS Driver;

- generating a downstream hashed-based message authentication code (HMAC) Key;

- validating a downstream hashed-based message authentication code (HMAC) using a downstream HMAC key; and

- decrypting an encrypted Traffic Encryption Key (TEK) using a Key Encryption Key (KEK), and returning the TEK to a DOCSIS Driver.

39. The interface of claim 1, wherein:

- the function of the terminal comprises managing objects that are downloaded by the terminal.

40. The interface of claim 1, wherein:

- the function of the terminal comprises searching for a currently loaded object and returning information thereof.

41. The interface of claim 1, wherein:

- the function of the terminal comprises searching for a next currently loaded object and returning

information thereof.

42. The interface of claim 1, wherein:  
the function of the terminal comprises registering  
as a manager for managed objects.

43. The interface of claim 1, wherein:  
the function of the terminal comprises creating and  
writing an object in one atomic operation,

44. The interface of claim 1, wherein:  
the function of the terminal comprises at least one  
of:  
preparing for an object to be written to memory,  
including allocating space the object;  
writing a portion of an object to memory; and  
terminating writing to object memory for a  
specified object.

45. The interface of claim 1, wherein:  
the function of the terminal comprises obtaining  
contents of a specified object.

46. The interface of claim 1, wherein:  
the function of the terminal comprises removing at  
least one object from memory.

47. The interface of claim 1, wherein:  
the function of the terminal comprises providing an  
object manager for receiving callbacks from a downloader  
regarding activity that occurs in the terminal related  
to downloaded objects.

48. The interface of claim 1, wherein:  
the function of the terminal comprises purchasing a program.

49. The interface of claim 1, wherein:  
the function of the terminal comprises at least one of:

- requesting that a program on a currently-tuned Virtual Channel Number be purchased;

- requesting that a purchase of a specified program be canceled;

- requesting that a program package indicated by a package name on a currently tuned Virtual Channel Number be purchased;

- requesting that a purchase of a specified packaged service be canceled; and

- requesting information regarding all pending purchases

50. The interface of claim 1, wherein:  
the function of the terminal comprises enabling a user of the terminal, following system start-up, to refresh a purchase callback function pointer for a specified program or package purchase.

51. The interface of claim 1, wherein:  
the function of the terminal comprises setting and/or checking a password.

52. The interface of claim 1, wherein:  
the function of the terminal comprises at least one of:

- setting the password for an indicated time slot;

and

verifying a indicated password for a particular time slot.

53. The interface of claim 1, wherein:  
the function of the terminal comprises initializing the at least one application program interface (API).

54. The interface of claim 1, wherein:  
the function of the terminal comprises verifying that the at least one application program interface (API) is running.

55. The interface of claim 1, wherein:  
the function of the terminal comprises configuring a platform of the terminal.

56. The interface of claim 1, wherein:  
the function of the terminal comprises checking the validity of dynamic random access memory (DRAM) installed in the terminal by returning the starting address, size and validity of the DRAM.

57. The interface of claim 1, wherein:  
the function of the terminal comprises returning the ENDIANness of a CPU of the terminal when the terminal is initialized.

58. The interface of claim 1, wherein:  
the function of the terminal comprises checking a validity of a non-volatile memory (NVMEM) of the terminal by returning the starting address, size and validity of the NVMEM

59. The interface of claim 1, wherein:

the function of the terminal comprises retrieving information about the terminal including at least one of the Platform ID, Manufacturer, Family and Model information.

60. The interface of claim 1, wherein:

the function of the terminal comprises retrieving the processor, bridge type and crystal speeds for the terminal,

61. The interface of claim 1, wherein:

the function of the terminal comprises retrieving MAC addresses for interfaces of at least one of DOCSIS, Ethernet, IEEE 1394, and USB components, and the terminal itself.

62. The interface of claim 1, wherein:

the function of the terminal comprises retrieving at least one of:

memory size information for memory components of the terminal;

at least one of cable modem and DOCSIS option information;

the type of output channel in use by the terminal;  
information regarding an IEEE 1394 interface installed in the terminal;

information regarding an Ethernet interface installed in the terminal;

information regarding a parallel port installed in the terminal;

information regarding the type of hard drive



currently installed in the terminal; and  
information regarding the type of platform and the  
version of the platform currently running in the  
terminal.

63. The interface of claim 1, wherein:  
the function of the terminal comprises diagnosing  
errors at the terminal.

64. The interface of claim 1, wherein:  
the function of the terminal comprises indicating  
the type of error when an error has occurred.

65. The interface of claim 1, wherein:  
the function of the terminal comprises  
providing diagnostic information regarding  
Interactive Pay-Per-View purchases at the terminal.

66. The interface of claim 1, wherein:  
the function of the terminal comprises providing  
diagnostic information regarding an output port or re-  
modulated port of the terminal.

67. The interface of claim 1, wherein:  
the function of the terminal comprises indicating  
at least one of:  
the last reset time, the type of reset that  
occurred and the last Fatal Error Log entry;  
a Virtual Channel Table ID for the virtual channel  
table that is resident in the terminal;  
a status of out-of-band stream components;  
a status of a current in-band multiplex;  
a unit addresses assigned to the terminal;

a status of the last attempted primary service acquisition;

a renewable security status;

a transmission status of a RF modem installed in the terminal;

a status for firmware loaded into flash memory and all versions of non-volatile code that are installed in the terminal; and

a memory configuration for the terminal.

68. The interface of claim 1, wherein:

the function of the terminal comprises retrieving DOCSIS diagnostic information for On Screen Diagnostics or reportback.

69. The interface of claim 1, wherein:

the function of the terminal comprises returning a status of at least one of:

a USB port;

any installed devices;

an IEEE 1394 port;

an Ethernet port;

a parallel port;

an infra-red (IR) transmitter;

an IR keyboard;

an IR remote control;

a smart card;

a hard drive; and

a graphics system.

70. The interface of claim 1, wherein:

the function of the terminal comprises

indicating whether a network adapter is available,

and associated parameters and/or status thereof.

71. The interface of claim 1, wherein:  
the function of the terminal comprises  
returning a Resource Authorization status for each  
resource in the terminal.

72. The interface of claim 1, wherein:  
the function of the terminal comprises returning a  
lock status of MPEG video and audio streams, as well as  
a Program Clock Reference (PCR).

73. The interface of claim 1, wherein:  
the function of the terminal comprises controlling  
an audio output of the terminal.

74. The interface of claim 1, wherein:  
the function of the terminal comprises setting the  
terminal's Audio Output Mode to one of: Surround,  
Stereo, and Mono.

75. The interface of claim 1, wherein:  
the function of the terminal comprises allowing a  
client to at least one of:  
set an Audio Control Volume Mode;  
enable or disable Audio Loop Thru to output an  
external audio source on baseband connectors, or mute  
the external audio source, respectively;  
set an Audio Compression Dynamic Range Compression  
Mode to one of: No Compression, Light Compression and  
Heavy Compression;  
select a Secondary Audio Program (SAP) Audio Source  
within an Analog Service, if available;

select the terminal's Digital Audio Output path instead of Analog Audio Output paths;

adjust the terminal's master audio volume, where the terminal adjusts left and right channel values;

adjust the terminal's master audio volume, including separate left and right channel values;

adjust the relative volume of TV audio sources, where the terminal adjusts left and right channel values;

adjust the relative volume of TV audio sources, including adjusts left and right channel values;

adjust the relative volume of local audio sources, where the terminal adjusts left and right channel outputs; and

adjust the relative volume of local audio sources, including left and right channel outputs.

76. The interface of claim 1, wherein:  
the function of the terminal comprises selecting at least one of:

a master Audio Mute mode on or off;

a TV Audio Mute mode on or off; and

a Local Audio Mute mode on or off.

77. The interface of claim 1, wherein:  
the function of the terminal comprises providing a single API call to report an Audio Status.

78. The interface of claim 1, wherein:  
the function of the terminal comprises controlling a video output of the terminal.

79. The interface of claim 1, wherein:

the function of the terminal comprises selecting a TV Video Blank mode on or off.

80. The interface of claim 1, wherein: the function of the terminal comprises controlling how a TV video is blanked by the terminal.

81. The interface of claim 1, wherein: the function of the terminal comprises providing a single API call to report a Video Status.

82. The interface of claim 1, wherein: the function of the terminal comprises authorizing a resource of the terminal.

83. The interface of claim 1, wherein: the function of the terminal comprises obtaining a permission status of a resource.

84. The interface of claim 1, wherein: the function of the terminal comprises at least one of:

registering a client to receive a notification when the authorization status of a resource changes; and canceling a previously set up registration to receive a notification when the authorization status of a resource changes

85. The interface of claim 1, wherein: the function of the terminal comprises providing a high definition passthrough.

86. The interface of claim 1, wherein:  
the function of the terminal comprises at least one  
of:

- obtaining a block of protected flash memory data  
containing DTCP data;
- writing a block of NVRAM data containing DTCP data;
- and
- reading a block of NVRAM data containing DTCP data.

87. The interface of claim 1, wherein:  
the function of the terminal comprises at least one  
of:

- providing an alphanumeric description of the  
terminal on an IEEE 1394 bus;
- defining the current state of a Digital Television  
(DTV) connection; and
- obtaining an IEEE 1394 5C System Renewability  
Message.

88. The interface of claim 1, wherein:  
the terminal comprises a television terminal.

89. A method for providing an interface to core  
system software in a user terminal, comprising the steps  
of:

- providing a computer readable medium having  
computer program code; and
- executing said computer program code to provide at  
least one application program interface (API) to enable  
middleware that mediates between an application program  
and the core system software to access a function of the  
terminal.

1/1

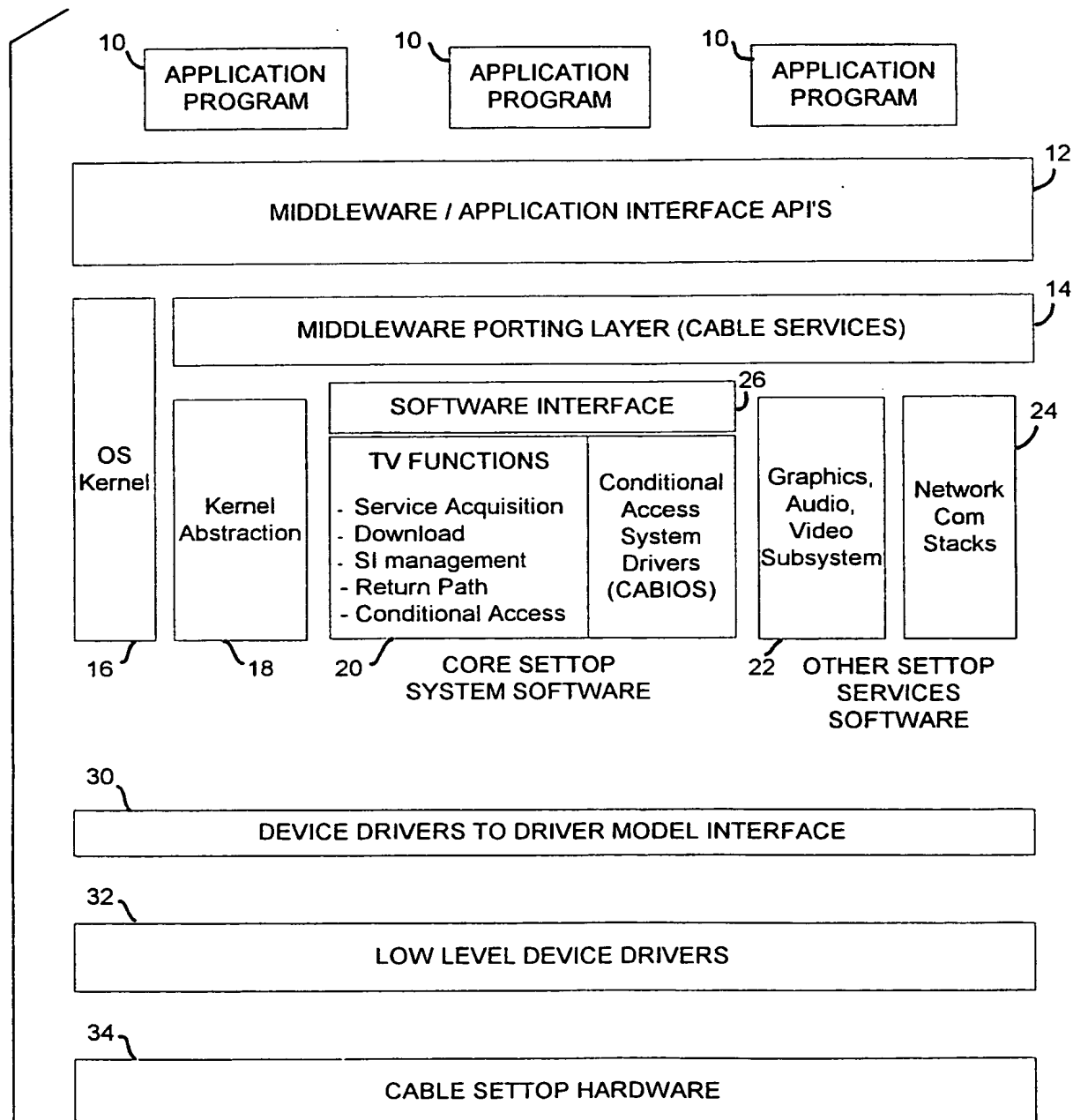


FIG. 1

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
30 November 2000 (30.11.2000)

PCT

(10) International Publication Number  
**WO 00/72586 A3**

(51) International Patent Classification<sup>7</sup>: H04N 5/00

(21) International Application Number: PCT/US00/12547

(22) International Filing Date: 8 May 2000 (08.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/135,268 21 May 1999 (21.05.1999) US

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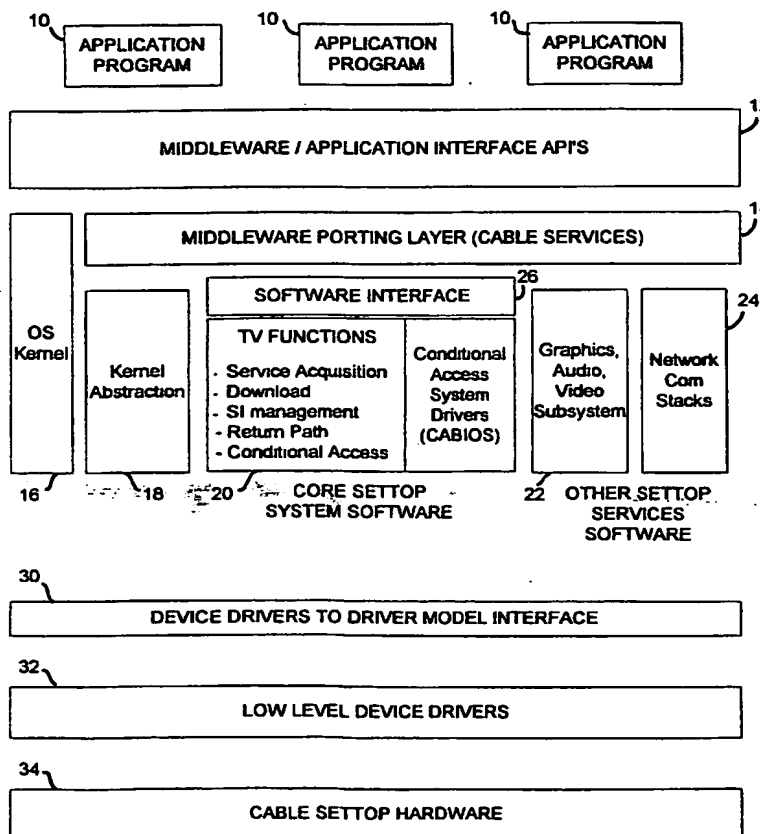
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU,

[Continued on next page]

(54) Title: PROGRAMMING INTERFACE FOR TELEVISION SETTOP CORE SYSTEM SOFTWARE



(57) Abstract: A software interface (26) is provided to enable television settop middleware (14) and operating system (OS) software (16) to control and interact with core settop system software (20) in a subscriber television terminal to facilitate the provision of desirable digital television services, including service acquisition (e.g., acquisition of a pay-per-view movie), system information management, settop configuration and control, return path for polling, download capability including authentication and authorization, and non-volatile memory management.

WO 00/72586 A3





MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:  
17 May 2001

**Published:**

— With international search report.

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 00/12547

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04N5/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MORNINGTON-WEST A: "MHEG-5 AND JAVA - THE BASIS FOR A COMMON EUROPEAN API?" EBU REVIEW- TECHNICAL, BE, EUROPEAN BROADCASTING UNION. BRUSSELS, no. 275, 21 March 1998 (1998-03-21), pages 11-15, XP000767494 ISSN: 0251-0936	1,88,89
Y		2-5,8, 10,11, 14,18, 19, 22-24, 27,28, 30-32, 34, 39-41, 43-46, 63-67, 69,70,
	-/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*A\* document member of the same patent family

Date of the actual completion of the international search

15 January 2001

Date of mailing of the international search report

05. 02. 2001

Name and mailing address of the ISA

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# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>GIC-575 PCT</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/US 00/ 12547</b>	International filing date (day/month/year) <b>08/05/2000</b>	(Earliest) Priority Date (day/month/year) <b>21/05/1999</b>
Applicant  <b>GENERAL INSTRUMENT CORPORATION et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 8 sheets.  
☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

### 4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

### 5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1  
☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 00/12547

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:  
**27-34, 39-47, 63-72, 82-84**
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-26,88,89

Providing service acquisition and service status APIs

2. Claims: 27-34

Providing system APIs

3. Claims: 35-36

Providing Unsolicited Event Indication APIs

4. Claims: 37-38

Providing Baseline Privacy Interface APIs

5. Claims: 39-47

Providing Downloader APIs

6. Claims: 48-50

Providing Purchase and Authorization APIs

7. Claims: 51-52

Providing password APIs

8. Claims: 53-54

Providing initialization APIs

9. Claims: 55-62

Providing Platform Configuration APIs

10. Claims: 63-72

Providing diagnostic APIs

11. Claims: 73-77

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Providing audio server APIs

12. Claims: 78-81

Providing video server APIs

13. Claims: 82-84

Providing resource authorizations

14. Claims: 85-87

Providing high definition passthrough APIs

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/12547

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04N5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MORNINGTON-WEST A: "MHEG-5 AND JAVA - THE BASIS FOR A COMMON EUROPEAN API?" EBU REVIEW- TECHNICAL, BE, EUROPEAN BROADCASTING UNION. BRUSSELS, no. 275, 21 March 1998 (1998-03-21), pages 11-15, XP000767494 ISSN: 0251-0936	1, 88, 89
Y		2-5, 8, 10, 11, 14, 18, 19, 22-24, 27, 28, 30-32, 34, 39-41, 43-46, 63-67, 69, 70,
	-/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

15 January 2001

Date of mailing of the international search report

05. 02. 2001

Name and mailing address of the ISA

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Authorized officer

Sindic, G

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/12547

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	page 12, middle column, paragraph 3 figure 1 ---	72,82
X	EVAIN J -P: "THE MULTIMEDIA HOME PLATFORM" EBU REVIEW- TECHNICAL, BE, EUROPEAN BROADCASTING UNION. BRUSSELS, no. 275, 21 March 1998 (1998-03-21), pages 4-10, XP000767493 ISSN: 0251-0936 page 7, right-hand column, paragraph 4 - paragraph 7 page 8, left-hand column, paragraph 10 page 9, left-hand column, paragraph 2 ---	1,88,89
Y	"PowerTV Application Development API Reference" 'ONLINE!, October 1998 (1998-10), pages 1-52, XP002146255 Retrieved from the Internet: <URL:www.powertv.com/docs/15/api_bk.pdf> 'retrieved on 2000-08-26! page 47 -page 49 ---	2-5,8, 10,11, 14,18, 19,22-24
Y	RATH K ET AL: "Set-top box control software: a key component in digital video" PHILIPS JOURNAL OF RESEARCH, NL, ELSEVIER, AMSTERDAM, vol. 50, no. 1, 1996, pages 185-199, XP004008210 ISSN: 0165-5817 ---	2,3
A	page 195, paragraph 3 ----- -/--	4-26



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/12547

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>"PowerTV Operating System Overview Release 1.5" 'ONLINE!', October 1998 (1998-10), pages 1-416, XP002157279 Retrieved from the Internet: &lt;URL:www.powertv.com/docs/15/oview_bk.pdf&gt; 'retrieved on 2001-01-15!</p>	<p>27,28, 30-32, 34, 39-41, 43-46, 63-67, 69,70, 72,82 42,47, 69,83,84</p>
A	<p>page 1-3 page 3-3 page 3-25 -page 3-26 page 5-1 page 5-5 -page 5-6 page 6-11 page 10-3 page 12-1 page 14-1 -page 14-5 page 15-1 -page 15-4 page 17-1 -page 17-9 page 17-14 -page 17-19 page 19-5 page 20-17 page 22-1</p>	
A	<p>----- EP 0 813 147 A (LSI LOGIC CORP) 17 December 1997 (1997-12-17) column 4, line 17 - line 20 column 11, line 48 -column 12, line 12 -----</p>	<p>69,83,84</p>
A	<p>US 5 841 987 A (DEISS MICHAEL SCOTT ET AL) 24 November 1998 (1998-11-24) abstract -----</p>	<p>29</p>

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/12547

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0813147 A	17-12-1997	US 5946487 A	31-08-1999
		JP 10069394 A	10-03-1998
US 5841987 A	24-11-1998	US 5568403 A	22-10-1996
		AU 5924996 A	15-01-1997
		AU 5929096 A	15-01-1997
		CN 1192838 A	09-09-1998
		CN 1193442 A	16-09-1998
		DE 69603366 D	26-08-1999
		DE 69603366 T	18-11-1999
		DE 69609070 D	03-08-2000
		DE 69609070 T	02-11-2000
		EP 0832535 A	01-04-1998
		EP 0832536 A	01-04-1998
		JP 11507755 T	06-07-1999
		JP 11507790 T	06-07-1999
		WO 9700579 A	03-01-1997
		WO 9700580 A	03-01-1997
		AU 698661 B	05-11-1998
		AU 3011595 A	29-02-1996
		CA 2154800 A	20-02-1996
		CN 1122990 A	22-05-1996
		EP 0701374 A	13-03-1996
		JP 8079705 A	22-03-1996
		SG 43666 A	14-11-1997

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 30 MAR 2001

WIPO

PCT

Applicant's or agent's file reference GIC-575 PCT	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/12547	International filing date (day/month/year) 08 May 2000 (08.05.2000)	Priority date (day/month/year) 21 May 1999 (21.05.1999)
International Patent Classification (IPC) or national classification and IPC IPC(7): G06F 9/44, 17/30; H04N 7/10; H04L 12/24 and US Cl.: 717/1, 10; 713/152; 709/9, 200, 219		
Applicant GENERAL INSTRUMENT CORPORATION		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 12 December 2000 (12.12.2000)	Date of completion of this report 14 February 2001 (14.02.2001)
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. 703 305-3230	Authorized officer ALVIN OBERLE <i>James R. Matthews</i> Telephone No. 703 305-3665

Form PCT/IPEA/409 (cover sheet)(July 1998)

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/12547

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

- ☒ the international application as originally filed.
- ☒ the description:  
pages 1-50 as originally filed  
pages NONE, filed with the demand  
pages NONE, filed with the letter of \_\_\_\_\_.
- ☒ the claims:  
pages 51-67 as originally filed  
pages NONE, as amended (together with any statement) under Article 19  
pages NONE, filed with the demand  
pages NONE, filed with the letter of \_\_\_\_\_.
- ☒ the drawings:  
pages 1 as originally filed  
pages NONE, filed with the demand  
pages NONE, filed with the letter of \_\_\_\_\_.
- ☐ the sequence listing part of the description:  
pages NONE as originally filed  
pages NONE, filed with the demand  
pages NONE, filed with the letter of \_\_\_\_\_.

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

- ☒ the description, pages NONE
- ☒ the claims, Nos. NONE
- ☒ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/12547

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. STATEMENT

Novelty (N)	Claims <u>1-89</u>	YES
	Claims <u>NONE</u>	NO
Inventive Step (IS)	Claims <u>1-89</u>	YES
	Claims <u>NONE</u>	NO
Industrial Applicability (IA)	Claims <u>1-89</u>	YES
	Claims <u>NONE</u>	NO

### 2. CITATIONS AND EXPLANATIONS (Rule 70.7)

Claims 1-89 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest An interface to core system software in a user terminal comprising a computer readable medium having computer program code; and means for executing the computer program code to provide at least one application program interface (API) to enable middleware that mediates between an application program and the core system software to access a function of the terminal.